# Chapter 3
# What has the Mining Program Accomplished?

## 3.1 Overview of Chapter 3

This chapter addresses the improvements to mineworker safety and health that have been realized over the past ten years, and that have resulted from the research and prevention activities of the NIOSH Mining Program. It is often difficult to establish causal relationships between research activities and tangible gains in safety or health measures, and the process is further complicated by the fact that multiple organizations or individuals have contributed to the sequence of events that has effected the desired health or safety outcome. We have organized the relationships between our research activities and the ultimate health or safety improvement into three categories of outputs, intermediate outcomes, and strategic program outcomes. Each of these will be defined here, and then additional remarks on who can rightly take credit for safety and health advancements will be offered in this introduction. Finally, the layout of this chapter is defined.

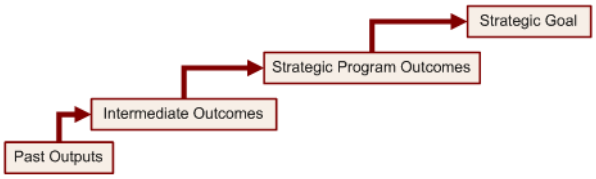
The execution of our research projects leads to defined deliverables or **outputs**. Outputs include papers published in peer-reviewed journals, articles in trade magazines, reports, workshops, and patents, among others, since 1996. Each output has intrinsic value, but only to the extent that it is translated into practice. For example, a specific technology to reduce dust entrainment may be developed and demonstrated as part of a project. Papers may be written on this technology and workshops may be conducted. These are important outputs of the research, but until they are put into practice, they cannot have much impact. The next step is therefore to identify outputs that have been applied with some measurable success.

The successful application of multiple research outputs leads to an **intermediate outcome**. Continuing with our example, suppose that as a result of the papers and workshops to promote the newly developed technology, the industry adopts it. The translation of these research outputs into practice is a necessary, but not sufficient condition, to define an intermediate outcome. The second necessary condition is that putting these into practice will contribute to the solution of a desired safety or health problem. In our example, if the adoption of the dust control technology throughout the industry also results in reduced dust exposure to workers, then a logical basis exists to believe that this will have an outcome of reducing dust diseases among mineworkers. Thus, the intermediate outcome in this example would be reducing dust exposure. We label these outcomes as intermediate to emphasize that they are, in themselves, not the final goal, but rather an intermediate step to the ultimate goal of positively impacting the safety and health measures.

The realization over time of one or more intermediate outcomes leads to a desired safety or health **strategic program outcome** - a reduction in the occupational illnesses, injuries, and fatalities related directly to one of the seven **strategic goals** of the Mining Research Plan (see Section 1.5). In our example, a reduction in dust exposure, in conjunction with other

intermediate outcomes, would be expected to lead to the strategic program outcome of a reduction in a lung disease associated with that dust. Of course, this final extension of the logic is more difficult to prove when the outcome, e.g. reducing coal worker pneumoconiosis, has a long latency period. Nonetheless, most experts would agree that a long-term reduction in exposure would have the desired outcome. The safety-based outcomes tend to be easier in this regard because the time period between the intermediate outcomes and the measurable changes in the desired outcome is shorter.

In summary, the accomplishments of the Mining Program are presented hierarchically, as follows:




Finally, there is the issue of determining the underlying causes of improvements to observable safety and health measures. At the output level, despite the often significant synergies among researchers at universities, private-sector research groups, and government agencies, it is usually straightforward to link a specific research project to a specific output. At the intermediate outcome level, however, this becomes more difficult. NIOSH outputs can be linked to measurable intermediate outcomes. However, in many cases the activities of others directly or indirectly contributed to those intermediate outcomes. In most cases, multiple intermediate outcomes are required to effect a change in the strategic outcome, and it is likely that NIOSH had involvement in only some of those. We are certain that NIOSH research and prevention activities have contributed to the measured improvements in mineworker safety and health. At the same time, we are certain that the activities of other non-NIOSH researchers have also contributed, and without the combined efforts of NIOSH and non-NIOSH researchers, these improvements would not have occurred. Moreover, the efforts of labor unions, industry groups, and enforcement agencies are absolutely essential to the process, and without their actions, little good would ever come of the research. For the purposes of this review, we have established plausible relationships between our past research activities and presently measurable changes in mineworker safety and health, and we have summarized the evidence that we believe supports these relationships. The remainder of this chapter presents those relationships and the supporting evidence.